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Toxic Hot Spot Study, South Platte River Along the Front Range, August and October, 1982

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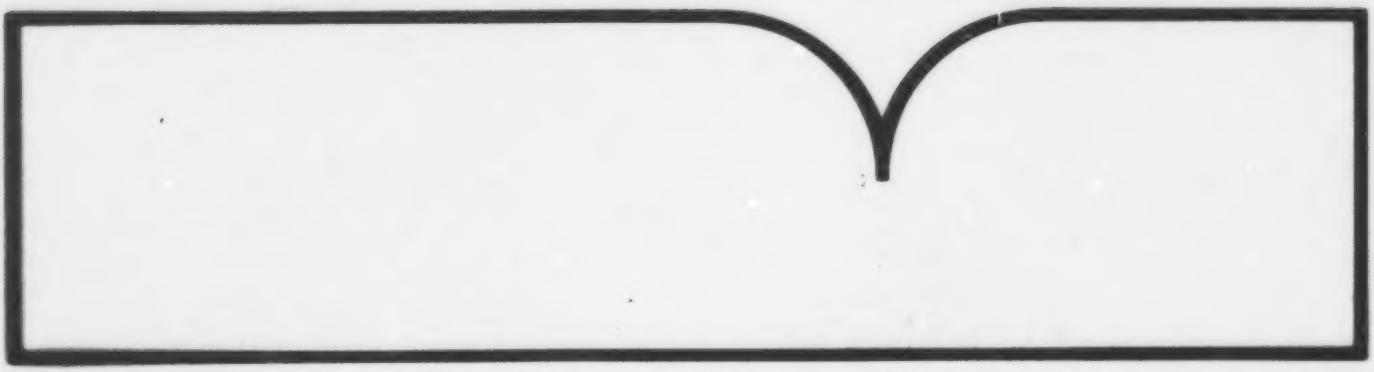

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16. ABSTRACT

To implement a Consent Decree between the EPA and the National Resources Defense Council requiring that EPA identify waters which may have toxic pollution problems, a two phase study was designed to determine if any Toxic Hot Spots exist in selected reaches of the South Platte River and selected tributary and non-tributary streams along the Front Range. Phase I was designed to determine if such "Toxic Hot Spots" exist and Phase II would focus on those areas defined in Phase I as "Toxic Hot Spots" and would include additional sampling locations.

In August and October, 1982, Phase I, a screening survey of the South Platte River and selected tributary and non-tributary streams along the Front Range, was conducted to determine where potential Toxic Hot Spots might exist. The area of study extended from just downstream of Chatfield Reservoir (THS-1/RM 334.9) to Kersey, Colorado (THS-24/RM 246.5). Samples of water, sediment and aquatic invertebrates were obtained for chemical and biological examination.

Results of the study indicate that no "Toxic Hot Spots" were found in the study area. An intensive Phase II study was not implemented.

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TOXIC HOT SPOT STUDY
SOUTH PLATTE RIVER ALONG THE FRONT RANGE
AUGUST, OCTOBER 1982

by

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REGION VIII

DENVER, COLORADO

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ABSTRACT

To implement a Consent Decree between the EPA and the National Resources Defense Council requiring that EPA identify waters which may have toxic pollution problems, a two phase study was designed to determine if any Toxic Hot Spots exist in selected reaches of the South Platte River and selected tributary and non-tributary streams along the Front Range. Phase I was designed to determine if such "Toxic Hot Spots" exist and Phase II would focus on those areas defined in Phase I as "Toxic Hot Spots" and would include additional sampling locations.

In August and October, 1982, Phase I, a screening survey of the South Platte River and selected tributary and non-tributary streams along the Front Range, was conducted to determine where potential Toxic Hot Spots might exist. The area of study extended from just downstream of Chatfield Reservoir (THS-1/RM 334.9) to Kersey, Colorado (THS-24/RM 246.5). Samples of water, sediment and aquatic invertebrates were obtained for chemical and biological examination.

Results of the study indicate that no "Toxic Hot Spots" were found in the study area. An intensive Phase II study was not implemented.

I. SUMMARY AND CONCLUSIONS

To implement a Consent Decree between the EPA and the National Resources Defense Council requiring that EPA identify waters which may have toxic pollution problems, a two phase study was designed to determine if any Toxic Hot Spots exist in selected reaches of the South Platte River and selected tributary and non-tributary streams along the Front Range. Phase I was designed to determine if such "Toxic Hot Spots" exist and Phase II would focus on those areas defined in Phase I as "Toxic Hot Spots" and would include additional sampling locations.

In August and October, 1982, Phase I, a screening survey of the South Platte River and selected tributary and non-tributary streams along the Front Range was conducted to determine where potential Toxic Hot Spots might exist. The area of study extended from just downstream of Chatfield Reservoir (THS-1/RM 334.9) to Kersey, Colorado (THS-24/RM 246.5). Samples of water, sediment and aquatic invertebrates were obtained.

Fecal coliform densities exceeded Colorado's 2000/100 ml standard at the station near Evans Avenue (THS-6/RM 324.7) and at the station near 19th and Grinnell (THS-8/RM-317.3) The Littleton/Englewood Bi-City wastewater treatment plant discharges to the river just upstream of THS-6 at RM 324.0.

Total iron concentrations in excess of Colorado's 1000 ug/l standard were measured in the South Platte River at the station near Evans Avenue (THS-6/RM 324.7), the station at 19th and Grinnell (THS-8/RM 317.3) and at the station near Henderson, Colorado (THS-13/RM 301.5). Total iron concentrations in excess of the standard set for the South Platte River were contributed by Lakewood Gulch (5770 ug/l), Cherry Creek (3300 ug/l), and Sand Creek (1160 ug/l). Iron concentrations in the sediment were significantly high at all stations.

With the exception of a 61 ug/l lead concentration at the Lakewood Gulch station (THS-5), lead concentrations at all other stations were not quantifiable. The laboratory results for the remaining metals examined in this study indicated that either the concentrations were less than the detectable limits of the test or that the concentrations were such as to be not quantifiable, based on approved methodology.

Gross alpha and gross beta determinations were used as indicators of radioactive contamination in water samples from the South Platte River and tributaries. Results indicate that no significant radioactive contamination was found at the sample stations in the study area.

With the exception of the phthalate ester analysis at station THS-17 on Coal Creek (58.2 ug/l), analyses for polychlorinated biphenyls (PCBs), phenol, 2,4,6 trichlorophenol, and phthalate esters indicated that either the concentrations were less than the detectable limits of the test or that something was there but in such small quantities as to be non-quantifiable. Phthalate esters are organic compounds used extensively as plasticizers in the plastic industry and as miticides and for insect control in agriculture. In the case of the Coal Creek station (THS-17), analysis of the biological samples does not seem to indicate any toxicity.

Analysis of the benthic samples collected from the South Platte River and selected tributary and non-tributary streams does not show any impact from potential toxic hot spots. Problem areas indicative of organic pollution were:

1. The reach of the South Platte River from downstream of the Littleton/Englewood Bi-City wastewater treatment plant.

2. The reach of the South Platte River from downstream of the Denver Metropolitan wastewater treatment plant.

Uncharacteristic high flows in the South Platte River preceeding the study contributed greatly to upgrading the water quality throughout the study area. Due to the improved water quality conditions with the increased flows, benthic organisms became more diverse. When the flows were reduced to facilitate the biological sampling, benthic organisms became concentrated, giving the impression of greater numbers of organisms per square meter and inflated organism densities. Given normal flow conditions, water quality could be degraded to a greater degree by organic pollution than was indicated by this study.

Results of the physical, chemical and biological findings indicate that no "Toxic Hot Spots" were found in the study area. There is no need for an intensive Phase II study at this time.

II. INTRODUCTION

A Consent Decree between the EPA and the National Resources Defense Council required that EPA identify toxicants, sources, and waters where point source discharges of 129 priority pollutants may interfere with attaining water quality goals. As part of the Regions' program to implement this activity, the Fate Model Studies were conducted which screened river reaches and resulted in toxic pollutant action recommendations. The toxic pollutant action recommendations urged the Regions to collect environmental data for specific river reaches which may have toxic pollution problems. To implement these recommendations, the Region conducted the Toxic Hot Spot Study. The parameters for the Toxic Hot Spot Study were reduced from the 129 priority pollutants to those toxic materials most generally found in the Fate Model Studies and those of particular interest to the Region.

Since the South Platte River along the Front Range includes the most highly developed areas in the Region, specific reaches of the river have a strong potential to be impacted by toxic materials. It was proposed that a two phase study be conducted on the South Platte River along the Front Range to determine if such "Toxic Hot Spots" exist and to what degree the river and tributaries are impacted.

Phase I was initiated in August, 1982 to determine where potential problem areas might exist, and included a screening survey of selected reaches of the South Platte River and selected tributary and non-tributary streams. Phase II of the study to be accomplished the following year would focus on those areas defined in Phase I as "Toxic Hot Spots". For Phase II, additional sampling locations would be established within the suspected areas and up to two weeks of intensive sampling would be required per area.

In Phase I, samples of water and sediment were collected for analyses at the Regional Laboratory at the Denver Federal Center. Certain physical and chemical measurements were made on site at the time of sample collection. Aquatic invertebrate samples were collected at all sites in October, 1982. These samples were returned to the Regional Laboratory for analyses. The Corps of Engineers reduced the flow from Chatfield Reservoir to the South Platte River for several days which permitted benthic sampling, but could not maintain lower flows long enough to allow for fish collection. Therefore the fish samples, though scheduled to be part of the Phase I study, were not obtained. Flow information was obtained from USGS and the State of Colorado.

This report is based on the results of the physical, chemical and biological findings.

III. DESCRIPTION OF THE STUDY AREA

The South Platte River Basin lies in northeastern Colorado, southeastern Wyoming, and southwestern Nebraska with more than 80% located in Colorado. This report is concerned only with that section of the South Platte River and tributaries indicated in Figure 1.

The segment of the South Platte River included in the study extends from just downstream of Chatfield Reservoir (Colorado Highway 470, River Mile (RM) 334.9) through the Denver metropolitan area downstream to the gaging station at the Highway 37 bridge (RM 246.5) approximately 1.5 miles (2.42 kilometers) north of Kersey, Colorado.

Tributary streams in the study area, in downstream order, are: Plum Creek, Bear Creek, Lakewood Gulch, Cherry Creek, Sand Creek, Clear Creek, Big Dry Creek, St. Vrain Creek, Boulder Creek, Coal Creek, South Boulder Creek, Big Thompson River, Little Thompson River and the Cache la Poudre River. Other non-tributary streams in the study area are O'Brian Canal, Burlington Ditch, and Fossil Creek

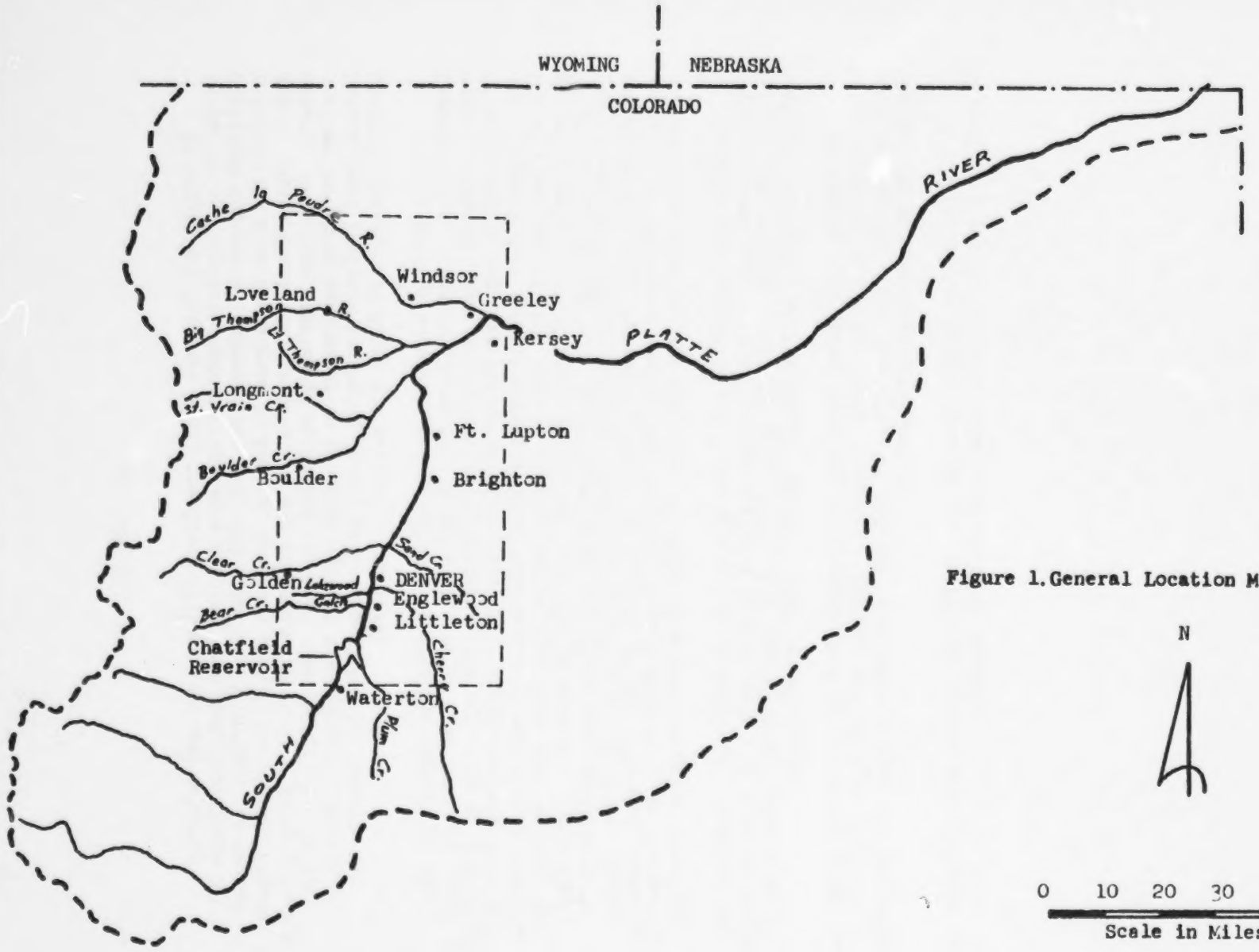


Figure 1. General Location Map

IV. METHODS

In August and October, 1982, the South Platte River and selected tributary and non-tributary streams were studied from just downstream of Chatfield Reservoir (Colorado Hwy 470, THS-1/RM 334.9) through the Denver metropolitan area downstream to Kersey, Colorado (THS-24/RM 246.5), Figures 1 and 2. Measurements for temperature and pH were made on-site using portable meters. Grab type samples of water and sediment were collected from each station for those parameters to be determined at the Regional Laboratory. Samples were analyzed according to the methods outlined in "Methods for Chemical Analysis of Water and Wastes" (EPA, 1979).

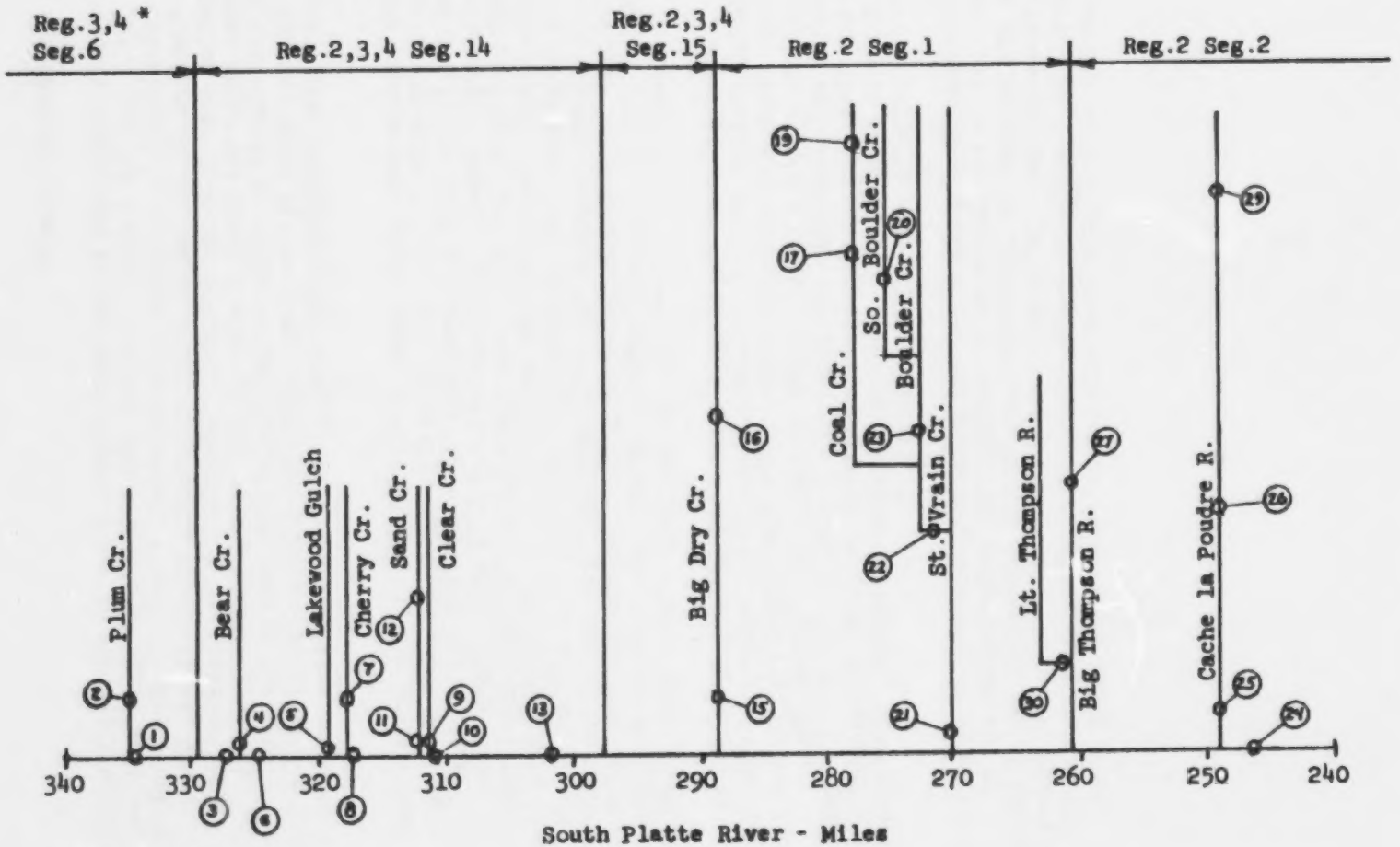
Several methods were utilized to collect qualitative samples of aquatic invertebrates Organisms were handpicked with forceps from selected rocks and debris. Organisms were also captured by holding a dip net close to the bottom of the riverbed and stirring up the substrate immediately upstream from the net. Quantitative samples were collected with a Surber square foot sampler. Three Surber square foot samples were collected from each sampling station where the water depth did not exceed one foot (0.305 meters). The bottom materials ranged from rock to shifting sand, and flows were sufficient to carry organisms into the sampler. The uncharacteristic high flows, common throughout the year, were not present at the time of the biological sampling. The Corps of Engineers reduced the discharge from Chatfield Reservoir several days prior to this part of the study to facilitate the biological sampling.

Samples were sieved in the field with a U.S. Standard No. 30 sieve and organisms remaining on the sieve were placed in pint jars with a preservative (water, 50%; alcohol, 40%; formalin, 10%). All samples were returned to the Regional Laboratory at the Denver Federal Center for processing.

All sample collection, handling and preservation was along the guidelines established in "A SOP for Field Samplers", "Methods for Chemical Analysis of Water and Wastes", and "Biological Field and Laboratory Methods for Measuring the Quality of Waters and Effluents".

A listing of the sample stations and analytical results are contained in Appendices A and B. Benthic data is detailed in Appendix C.

Figure 2. Schematic Map-Station Locations



* Colorado WQS

V. RESULTS OF THE STUDY

Physical and Chemical Results

Pollutants discharged to the South Platte River in the reach bounded by THS-6/RM 324.7 and THS-8/RM 317.3 caused the 2000/100 ml fecal coliform standard established by Colorado to be exceeded, Figure 3. Fecal coliform bacteria numbered 30,000/100 ml within this reach (South Platte River at the gaging station near 19th and Grinnell, THS-8/RM 317.3). Lakewood Gulch and Cherry Creek enter the South Platte in this reach, however the fecal coliform densities contributed by these tributaries did not exceed the 2000/100 ml standard for the South Platte River during the study. The Littleton/Englewood Bi-City wastewater treatment plant however discharges in this reach at RM 325.0.

At the station near Evans Avenue (THS-6/RM 324.7), the station near 19th and Grinnell (THS-8/RM 317.3), and the station near Henderson, Colorado (THS-13/RM 301.5) the 1000 ug/l standard for total iron was exceeded, Figure 4. In these areas Lakewood Gulch contributed 5770 ug/l, Cherry Creek contributed 3300 ug/l, and Sand Creek contributed 1160 ug/l total iron to the South Platte River. Throughout the entire reach of the South Platte River included in this study, the sediment contained high iron concentrations, Figure 5. A maximum concentration of 32,000 ug/g iron was in the sediment at the station near Evans Avenue (THS-6/RM 324.7). At the sampling point on Lakewood Gulch (THS-5) a concentration of 30,000 ug/g iron was measured in the sediment. Lakewood Gulch is tributary to the South Platte River at RM 319.4.

With the exception of the 61 ug/l total lead concentration at the Lakewood Gulch station (THS-5), concentrations at all other stations indicated something was there but not quantifiable. The laboratory results for the remaining metals examined in this study indicated that either the concentrations were less than the detectable limits of the test or that something was there but in such small quantities as to be non-quantifiable, based on approved methodology. Where values were determined, concentrations did not exceed criteria where known, Appendix B.

The measurement of gross alpha and gross beta activity in water is a significant tool in the detection of radioactive contamination and an indication of the need for additional data on the concentrations of the more hazardous radionuclides. Using gross alpha and gross beta as indicators of radioactivity, no significant radioactive contamination was found in the samples from the South Platte River and tributaries in the study areas.

Figure 3. Bacterial Densities, South Platte River

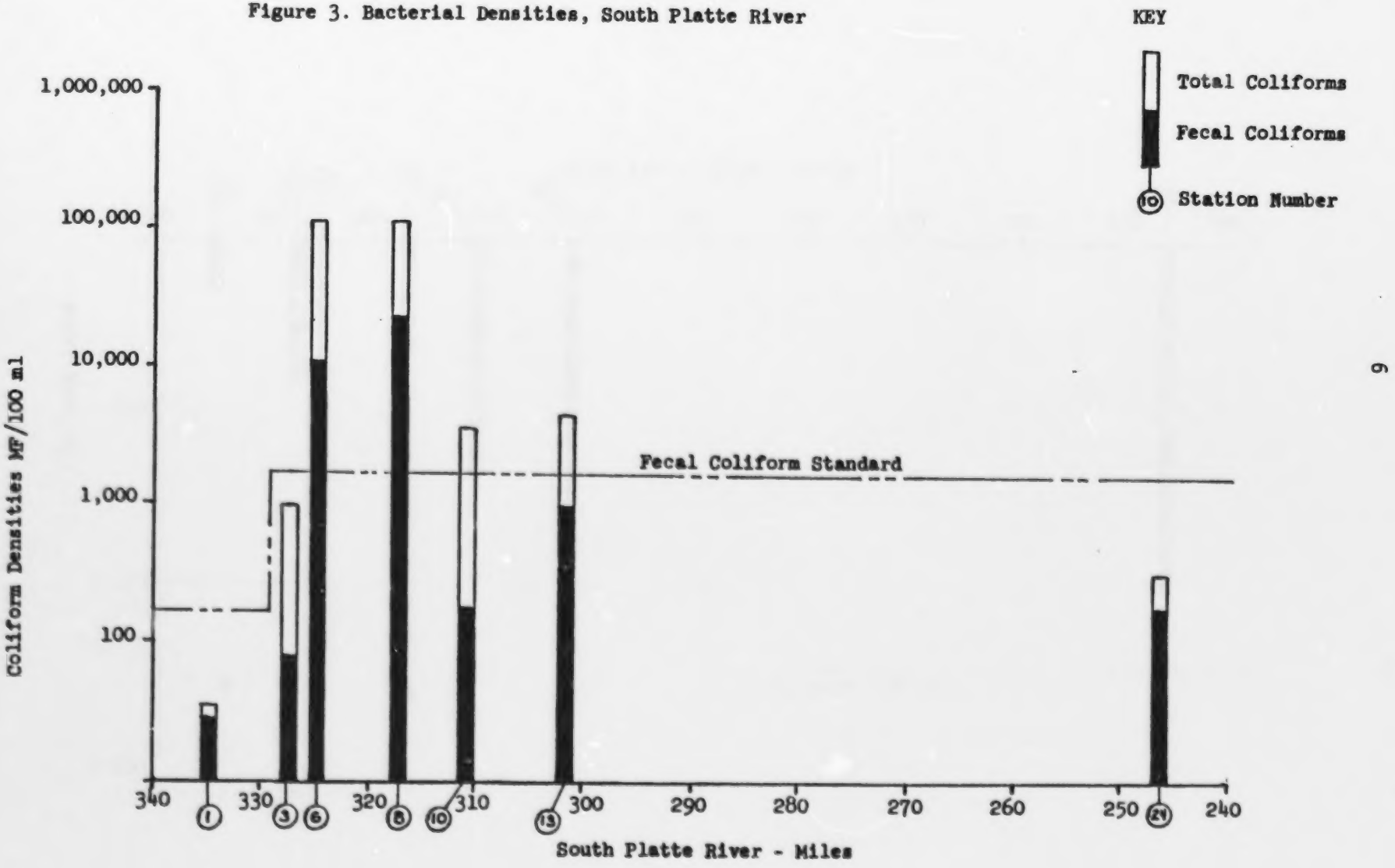


Figure 4. Total Iron Concentrations, Water, South Platte River

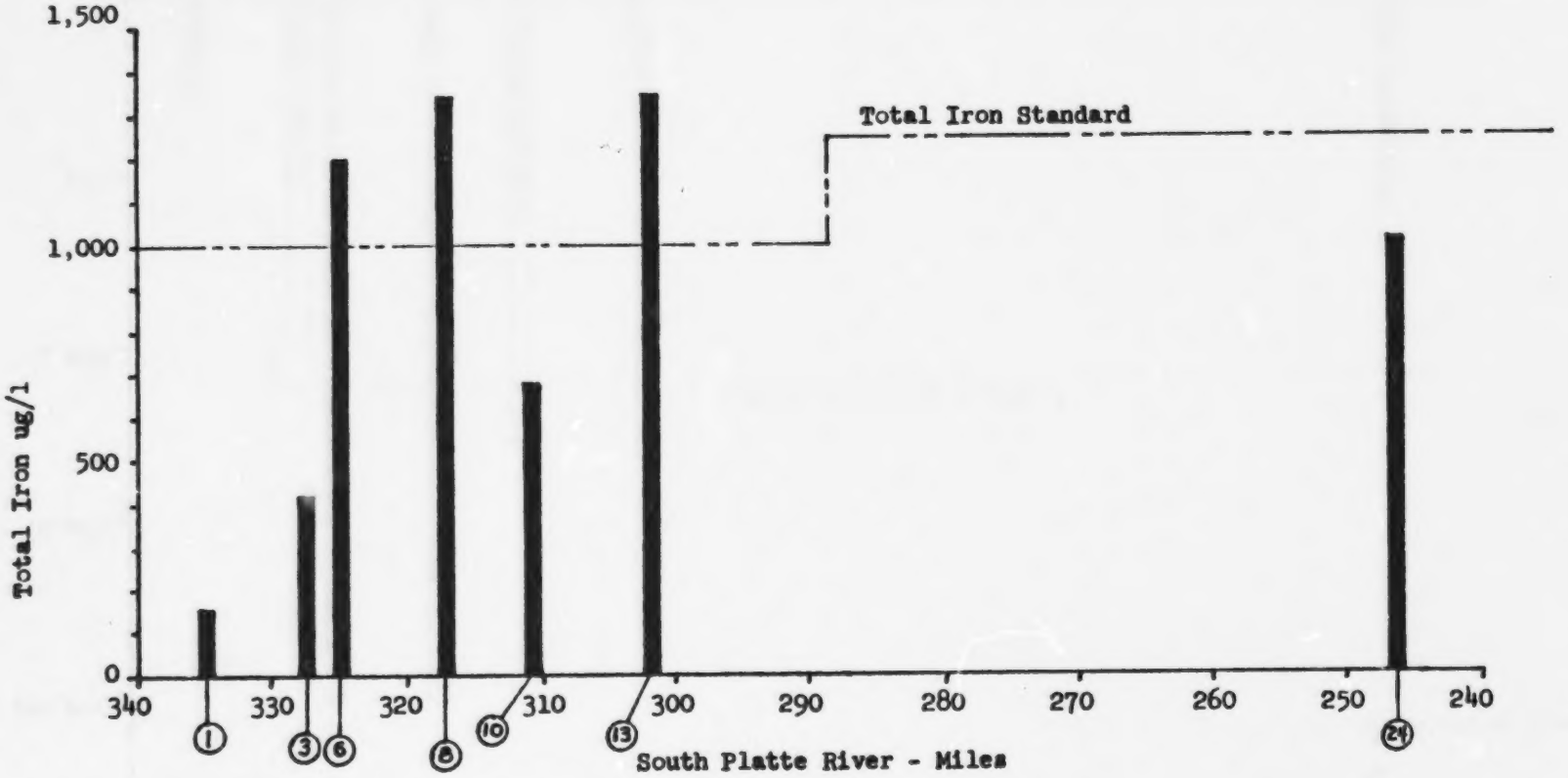
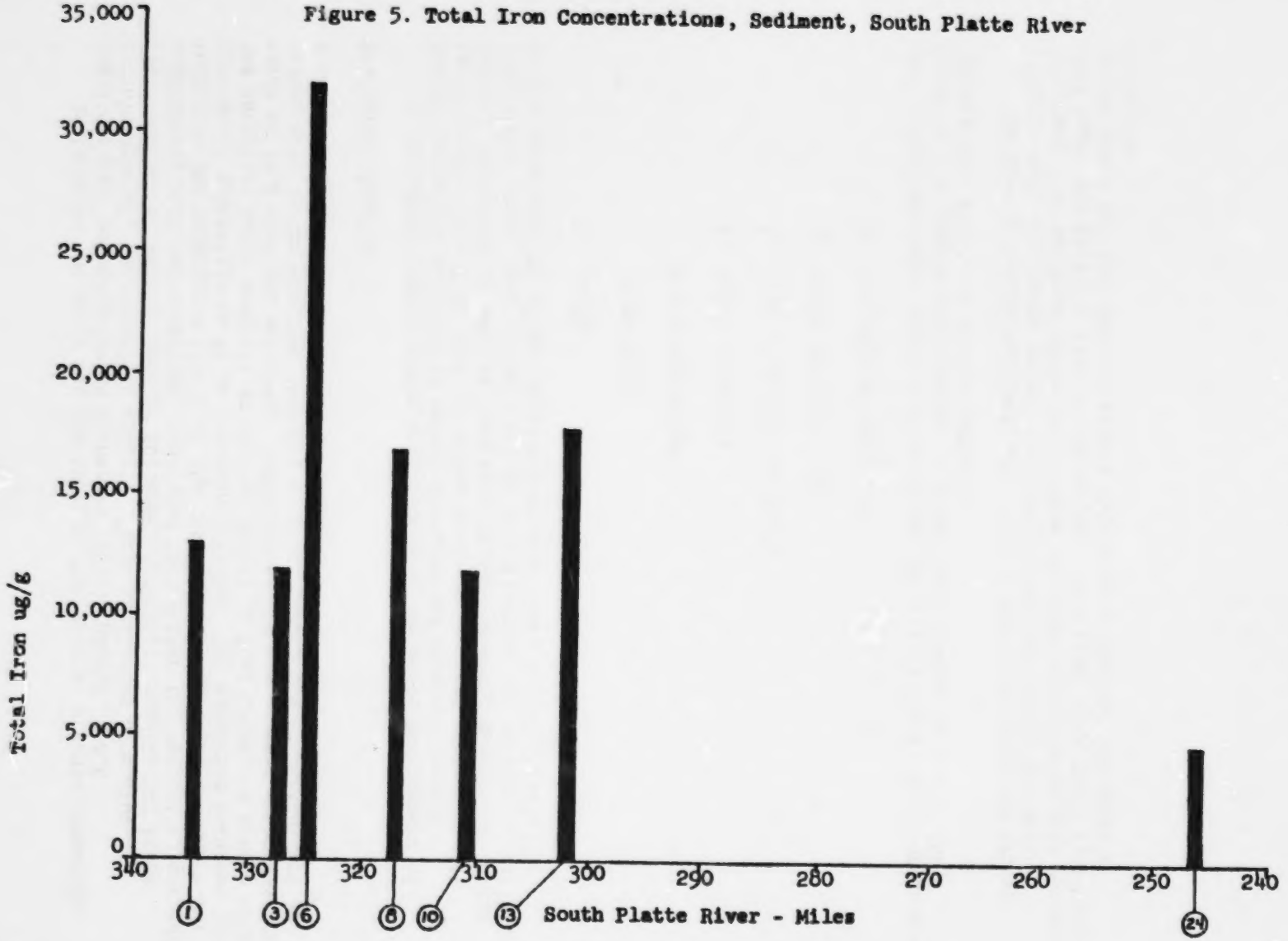


Figure 5. Total Iron Concentrations, Sediment, South Platte River



Included in the study was the analyses for several organic compounds. These included polychlorinated biphenyls (PCBs), phenol, 2,4,6 trichlorophenol, and phthalate esters. These substances have wide distribution in industry and agriculture. Analytical results for these substances, with one exception, indicated that either the concentrations were less than the detectable limits of the test or that something was there but in such small quantities as to be non-quantifiable. The exception occurred for the phthalate ester analysis at station THS-17 on Coal Creek. A single high value of 58.2 ug/l was measured. Phthalate esters are organic compounds used extensively in the plastics industry as plasticizers and in agriculture as orchard miticides and for insect control.

Biological Results

A biological investigation will determine the kinds and numbers of benthic organisms existing in select areas of the stream. Aquatic invertebrates have life spans of a few months to several years and will reflect short-term as well as long-term changes in water quality or bottom conditions, thus, they are well suited to evaluating the effects of pollutants on the water quality of the receiving stream. Many factors, including:

1. Light
2. Temperature
3. Dissolved oxygen
4. Toxic materials
5. Type of bottom substrate
6. Depth of water, and
7. Velocity of the water

will affect the total numbers of organisms as well as the kinds of organisms found in the aquatic environment. A significant change in any of these factors will alter the biotic community.

The type of bottom substrate will have a bearing on organism productivity. Rock and coarse gravel are suitable bottom habitat for most organisms. It has been shown that bottom organism productivity will decrease when substrate particle size is decreased. Fine sand, with small interstital spaces and a shifting nature, offers little or no habitat for aquatic organisms.

Water quality changes may adversely affect aquatic organisms. Some organisms will be destroyed, while others are able to tolerate severe environmental changes. A non-polluted or clean-water environment, with adequate bottom substrate, will support large numbers of kinds of aquatic organisms and each kind will be represented by a small number of individuals. Most of the organisms will be of the pollution-sensitive types such as stonefly, mayfly and some caddisfly larvae. An organically enriched or intermediate situation would exhibit a reduction in the number of kinds of aquatic organisms present. Pollution sensitive stonefly and most mayfly larvae would be eliminated. Caddisfly larvae would increase in numbers as competition for the available food supply was reduced. An organically enriched environment would greatly increase the available food supply but would also decrease the dissolved oxygen concentration. Pollution-sensitive organisms such a stonefly, mayfly and some species of caddisfly larvae would be eliminated from the aquatic environment. Due to decreased predation and competition for available food resources, the remaining intermediate and pollution-tolerant organisms such as midges, blackflies and sludgeworms multiply in great numbers. As a result, the total number of organisms will increase while the numbers of kinds of organsims will decrease.

Toxic materials will reduce both diversity and total numbers of organisms immediately downstream from the point of discharge. Severely toxic wastes will eliminate all benthic organisms from a given environment. Moderately toxic wastes, on the other hand, will eliminate those organisms most susceptible to the substance. As toxic materials move downstream and are diluted or otherwise rendered harmless, detrimental effects are reduced and the aquatic community will increase in both kinds and total numbers given proper habitat and flow. In addition to serving as a pollution indicator, the aquatic community serves as a major link in the aquatic food chain; algae to bottom animals to fish.

Aquatic invertebrates collected at the control station, approximately 0.25 miles (0.4 kilometers) downstream of Chatfield Reservoir (THS-1/RM 334.9), were predominately intermediate and pollution-tolerant organisms, with a population density of 106 organisms per square foot (1722 per square meter). Appendix C. Approximately 20% of the total number or organisms were pollution sensitive mayfly larvae. The bottom substrate at this station consisted of cobble, shale and sand with some large rocks cemented in with silt and sand.

Plum Creek at Teel Stable (THS-2/RM 335) enters Chatfield Reservoir upstream of the control station (THS-1). Since there was an existing toxic waste site upsteam of Teel Stables, one qualitative sample was collected at this station. Fine gravel and coarse sand comprised the bottom substrate. Clean-water associated organisms such as stonefly and caddisfly larvae were the predominate types handpicked from selected over-hanging foliage and debris. Any contribution by Plum Creek is masked by Chatfield Reservoir and does not affect the control station (THS-1) downstream of the reservoir.

Downstream 7.9 miles (12.6 kilometers) from the control station, the South Platte River at Oxford Avenue (THS-3/RM 327) supported a diverse population of aquatic invertebrates, Appendix C. Bottom organisms numbered 256 per square foot (2755 per square meter), with a diversity of 9 kinds. Pollution-sensitive and intermediate organisms comprised 36 and 32% respectively of the total population. Pollution-tolerant species comprised 30% of the bottom organisms collected. This station is indicative of an enriched, but unpolluted, condition.

Downstream of the Littleton/Englewood Bi-City wastewater treatment plant discharge, approximately one mile (1.6 kilometers), the benthic community increased from 256 per square foot (2755 per square meter) at the South Platte River station near Oxford Avenue (THS-3) to 2598 per square foot (27,954 per square meter) in the river near Evans Avenue (THS-6/RM 324.7), Figure 6. The invertebrate population increased from 30% pollution-tolerant organisms at Oxford Avenue to 88% at Evans Avenue, indicating organic degradation. Pollution-tolerant organisms consisted of sludgeworms, leeches, midge larvae and blackfly larvae. The fecal coliform densities support the biological observations. At THS-3 the fecal coliform density was 88/100 ml, as compared to 11,400/100 ml at THS-6, a 130 fold increase, Figure 3. The aquatic insect population at this station was indicative of organic pollution. The Littleton/Englewood wastewater treatment plant discharges to this segment of the stream.

Lakewood Gulch (THS-5/RM 319.4), a tributary stream entering the South Platte River approximately 5 miles (8 kilometers) downstream from Evans Avenue, exhibited a diverse population of bottom organisms. The benthic community averaged 247 organisms per square foot (2658 per square meter), with 11 kinds present, Appendix C. Pollution-sensitive mayfly and intermediate caddisfly larvae comprised 36% of the organisms collected. Pollution-tolerant midges, sludgeworms and craneflies totalled 64% of the aquatic invertebrates collected. The bottom substrate consisted of rock, gravel and sand cemented by silt and clay. Periphyton were attached to the existing substrate in 4-10 inch (10.16-25.4 cm) long strings, indicating possible enrichment of the sampling site.

Coarse sand comprised the bottom substrate at the Cherry Creek sampling station (THS-7/RM 317.7). One qualitative sample was collected from selected rocks and debris. Pollution-tolerant organisms were the dominant types found at this station, Appendix C. Bottom organisms collected at this station were indicative of an enriched stream.

Downstream of the confluence of Cherry Creek and the South Platte River, benthic samples were collected from the river near 19th and Grinnell (THS-8/RM 317.3). The benthic population numbered 527 per square foot (5671 per square meter) with 9 different kinds. Pollution-tolerant organisms, sludgeworms, midges and blackflies, comprised 90% of the organisms collected. Fecal coliform data showed almost a three fold increase over the upstream station at Evans Avenue, 11,400/100 ml as compared to 30,000/100 ml, Figure 3. Water quality degradation was still evident in this reach of the South Platte River. The benthic population identified was indicative of an organically polluted habitat.

Clear Creek (THS-9/RM 311.1), upstream of its confluence with the South Platte River approximate 1/2 mile (0.8 km), supported a diverse population numbering 237 per square foot (2550 per square meter), with 11 kinds present, Appendix C. Pollution-sensitive mayfly and intermediated caddisfly larvae made up 43% of the organisms observed.

Downstream from the Denver Metropolitan wastewater treatment plant approximately 1.25 miles (2 km), poor substreate composition precluded any in-depth sampling at this South Platte River station (THS-10/RM 310.9). One qualitative sample was collected. Pollution-tolerant organisms indicative of a polluted situation comprised the majority of the organisms collected.

Approximately 10 miles (16 kilometers) downstream from the Denver Metropolitan wastewater treatment plant, the South Platte River near Henderson (THS-13/RM 301.5) supported a highly abundant benthic population. Aquatic organisms numbered 3878 per square foot (41,727 per square meter), Figure 6. Pollution-tolerant sludgeworms, midges, blackflies and snails, typical of the influence of organic pollution were found. Periphyton streamers were also observed attached to the substrate.

Big Dry Creek at Colorado Highway 121 (THS-16/RM 289/26.2) supported a diverse population of aquatic invertebrates; 12 kinds were present, Figure 7. One qualitative sample was collected. Pollution sensitive organisms as well as pollution-tolerant organisms indicative of an enriched but non-polluted situatiion were observed. Substrate composition consisted of rock to shifting sand.

Downstream for THS-16 22 miles (35.2 kilometers) the substrate composition at Big Dry Creek at County Road 23 (THS-15/RM 289/4.2) was not conducive for sampling. Since mud and silt made up the substrate, only one qualitative sample was collected. Benthic organisms tolerant to organic pollution comprised the entire sample, reflecting a degraded water quality.

Coal Creek at Highway 72 (THS-19/RM 270/17/4/7.9/29.9), supported a population of bottom organisms numbering 1910 per square foot (20,551 per square meter) with a diversity of 27 species, Appendix C. The organisms collected were predominantly pollution-sensitive stoneflies, mayflies, and intermediate caddisflies. The substrate consisted of cobble to small rocks over sand and bedrock. Intermediate caddisflies totalled 66% of the population, indicating some form of enrichment.

Downstream of THS-19, Coal Creek at Superior (THS-17/RM 270/17.4/7.9/21.3) supported bottom organisms numbering 2679 per square foot (28,826 per square meter) and 21 kinds. Pollution-sensitive mayfly and intermediate caddisfly larvae comprised 28% and 44% respectively of the population. Stoneflies were not found at this station, Appendix C. Pollution-tolerant organisms increased from 3% at station THS-19 to 13% at THS-17. This could be due, in part, to a change in substrate composition; cobble and sand, as compared to cobble and rock. Also, biogeographical locations could affect species diversity. THS-19 is a montane region with clear water flowing over a shaded cobble and sand bottom; while THS-17 is a prairie setting, with slower water flow over a cobble and silt bottom. The stream at THS-17 is exposed to more sunlight and influenced by agricultural activity which can produce an enriched water quality, Figure 8.

South Boulder Creek at Eldorado Springs (THS-20/RM 270/17/4/21.0/8.6), supported a diverse and abundant benthic population. Twenty-seven kinds of bottom organisms numbering 555 per square foot (5972 per square meter) were collected. Clean water associated stoneflies and mayflies comprised 27% of the population. Intermediately pollution sensitive caddisfly larvae made up 64% of the benthic organisms. Pollution-tolerant midges and blackflies totalled 8% of the total population of aquatic invertebrates. This type of benthic population was indicative of an unpolluted stream.

St. Vrain Creek at Wildcat (THS-21/RM 270/1.3) was a slow moving stream with a substrate composed of shifting sand. This type of substrate offers little or no habitat for bottom organisms. One qualitative sample with a very small number of organisms was collected. Pollution-tolerant organisms comprised the total sample. Due to the small number of organisms collected, an inferance to water quality was not made.

Boulder Creek at Highway 287 (THS-23/RM 270/17.4/10.1) supported a diverse population of aquatic invertebrates. Bottom organisms numbered 848 per square foot (9124 per square meter) with a diversity of 11 kinds, Appendix C, Figure 9. Pollution-sensitive mayfly larvae comprised 18% of the total number of organisms. Pollution-tolerant organisms such as midges, sludgeworms and blackflies made up 65% of the population, indicating a degraded water quality.

Downstream of THS-23 6.5 miles (10.4 kilometers), Boulder Creek at County Road 20 1/2 (THS-22/RM 270/17/4/11/6), water quality degradation was still evident. Bottom organisms numbered 916 per square foot (9856 per square meter). This station supported a reduced diversity of 8 kinds, as compared to 11 kinds at station THS-23. Pollution-tolerant organisms totalled 99% of the organisms collected.

East of Loveland, Colorado, the Big Thompson River (THS-27/RM 260.4/21.0) supported aquatic life indicative of an unpolluted system, Appendix C. Benthic organisms numbered 441 per square foot (4745 per square meter) with 8 kinds present, Figure 10. Pollution-sensitive mayfly and caddisfly larvae totalled 76% of the bottom organisms collected. Pollution-tolerant sludgeworms, midges and blackflies comprised only 24% of the aquatic invertebrates.

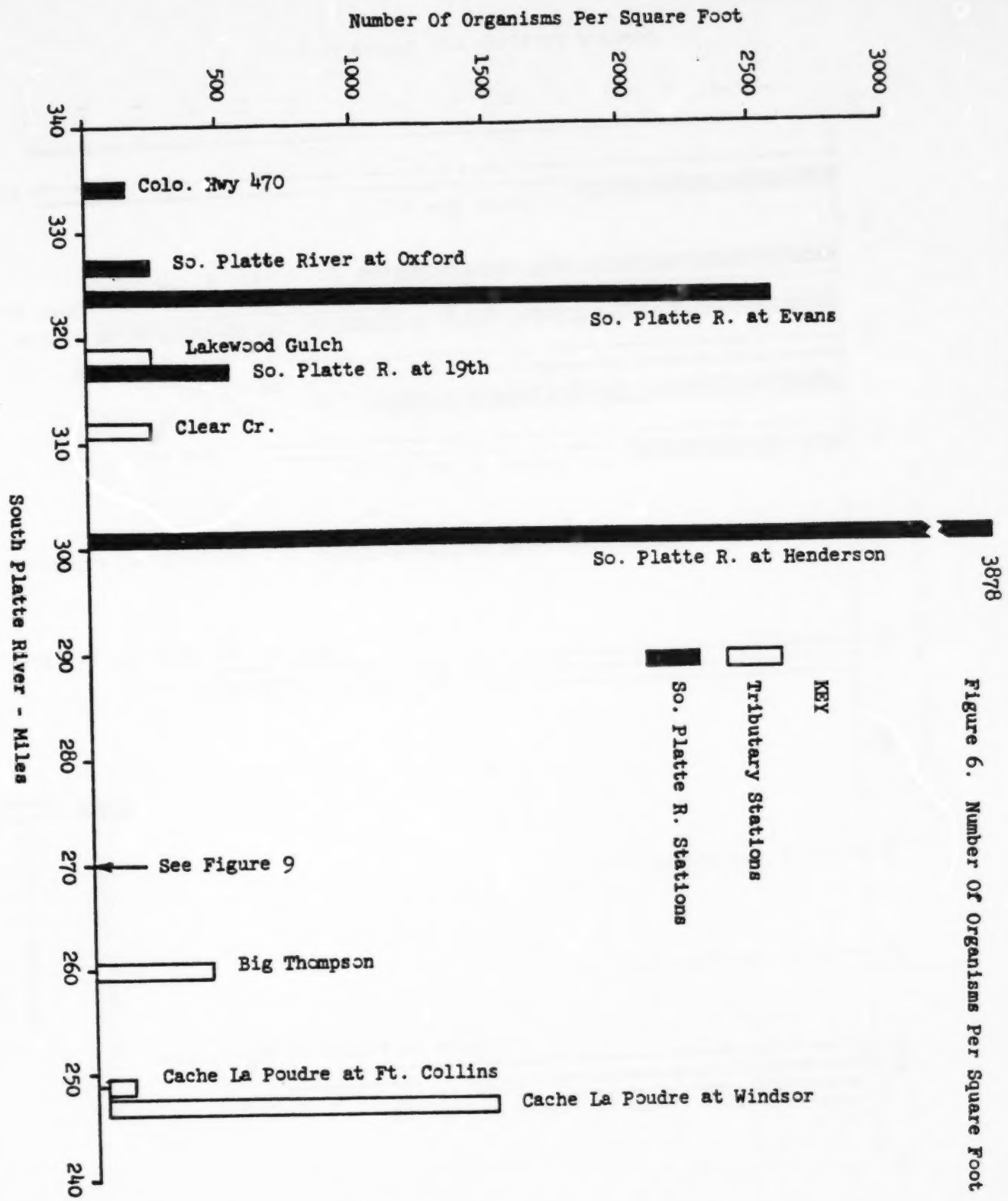


Figure 6. Number Of Organisms Per Square Foot

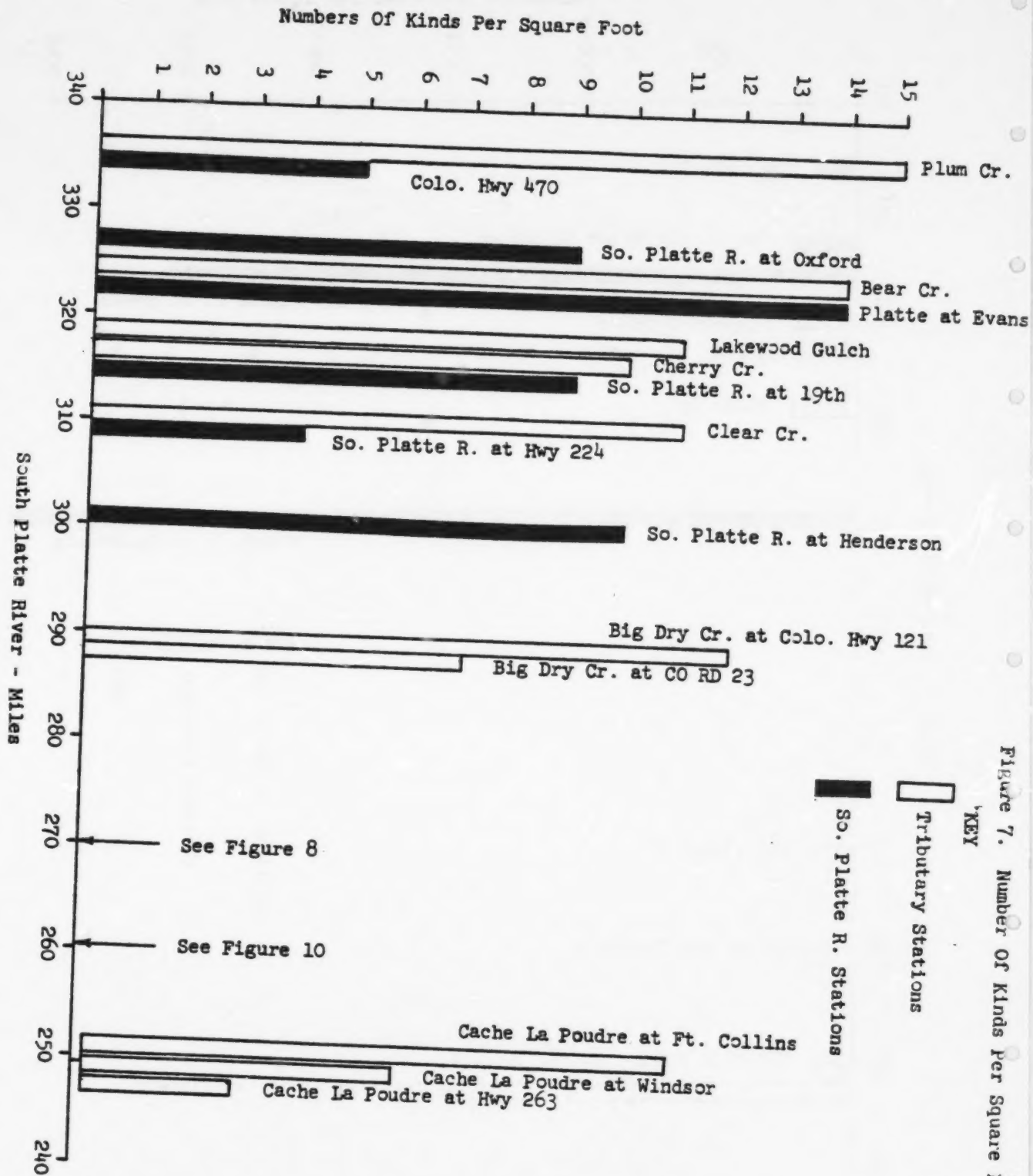


Figure 7. Number Of Kinds Per Square Foot

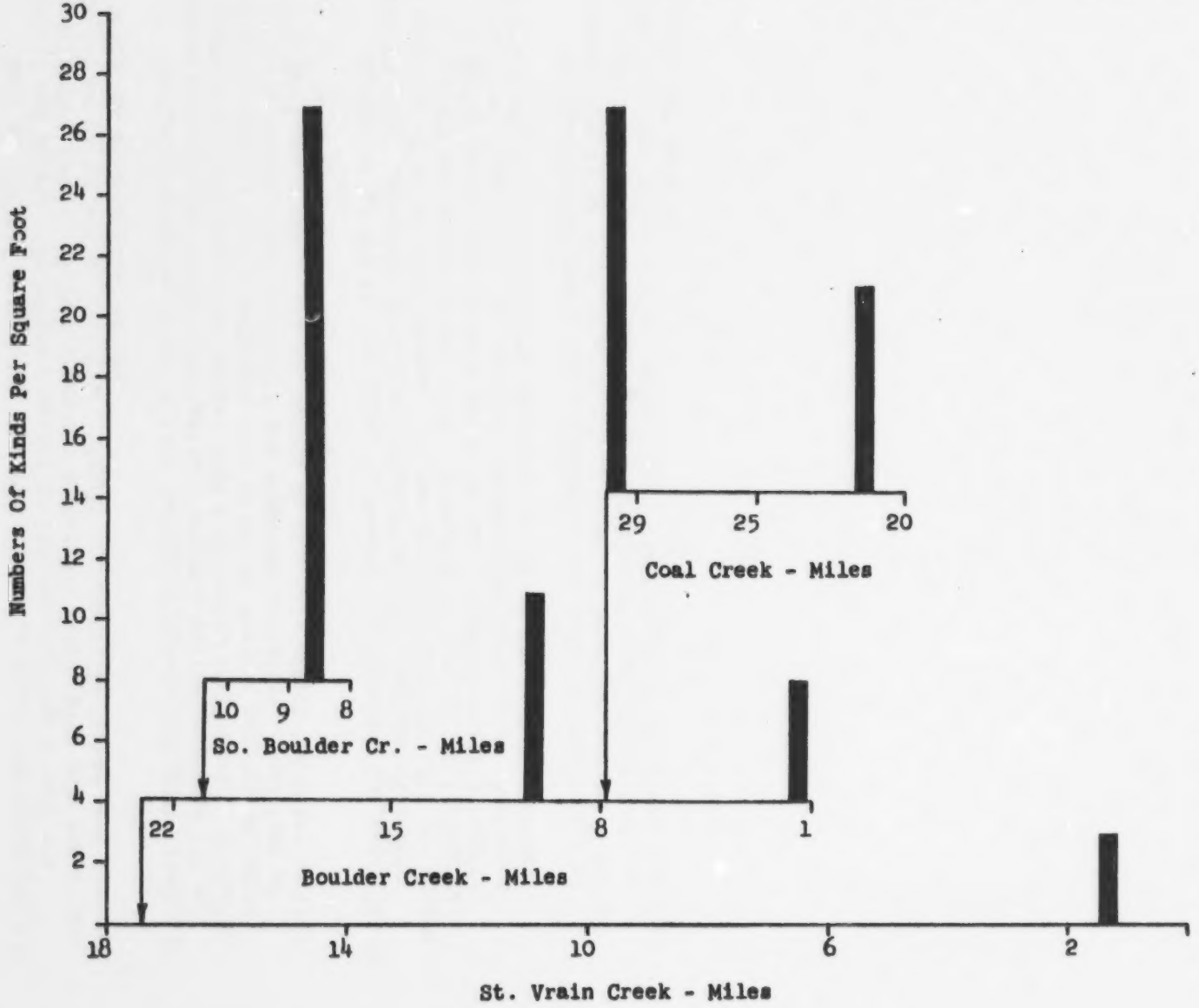
West of Miliken, Colorado, the Little Thompson River (THS-30/RM 260.4/7.0/0.1) was turbid. Substrate composition limited sampling to only one qualitative sample. Bottom organisms numbered 7 kinds, with only one or two organisms collected for each kind. Mayfly and caddisfly larvae were observed, indicating an unpolluted stream.

The Cache La Poudre River at Fort Collins, Colorado (THS-29/RM 249/43.6) supported a diverse benthic population. Bottom organisms numbered 177 per square foot (1905 per square meter) with a diversity of 11 kinds. Pollution-sensitive mayfly larvae comprised only 6% of the benthic population, while caddisfly larvae totalled 58% of the organisms collected. Some form of enrichment was evident, but not enough to adversely affect the water quality, as reflected by the aquatic community.

Downstream of THS-29, the Cache La Poundre near Windsor, Colorado (THS-26/RM 249/18.5) supported an abundant population with a reduced diversity, indicative of an enriched stream. Bottom organisms totalled 1511 per square foot (16,258 per square meter) with a diversity of 6 kinds. Pollution-sensitive mayfly larvae made up only 4% of the total population while caddifly larvae comprised 61% of the aquatic invertebrates identified. Pollution-tolerant midges and blackflies increased to 33% of the bottom organisms.

One qualitative sample was collected on the Cache La Poudre east of Greeley (THS-25/RM 249/2.9) with only 3 kinds of organisms present. Pollution-tolerant midges and blackflies, indicative of a polluted situation, comprised the entire sample. High flows in this reach of the river precluded any further sampling.

Figure 8. Numbers Of Kinds Per Square Foot



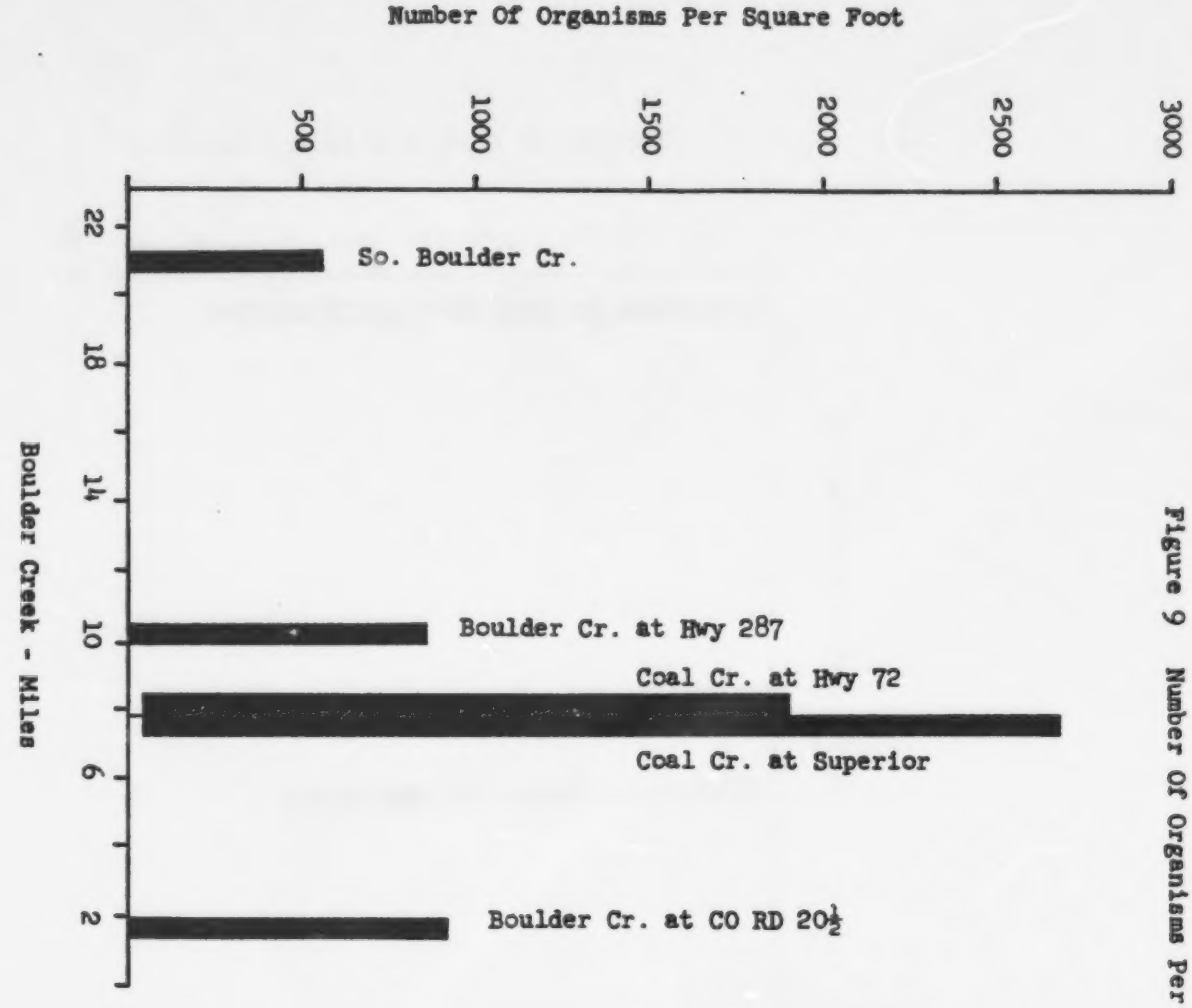
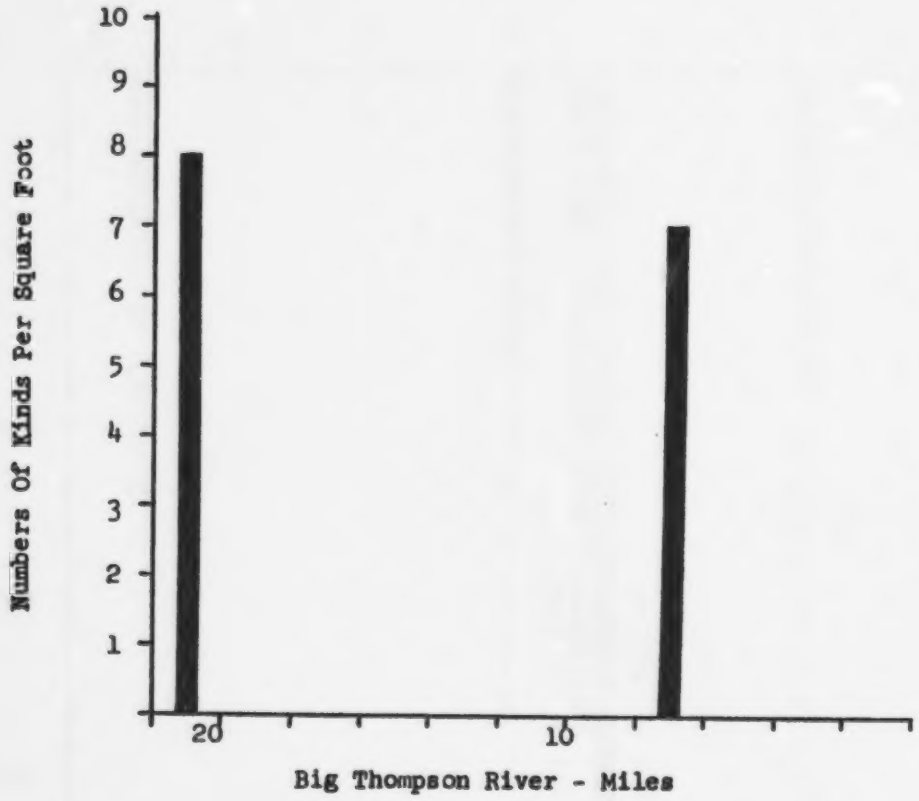


Figure 9 Number Of Organisms Per Square Foot

Figure 10. Numbers Of Kinds Per Square Foot



REFERENCES

1. REPORT ON WATER QUALITY INVESTIGATIONS IN THE SOUTH PLATTE RIVER BASIN, COLORADO. Environmental Protection Agency, National Field Investigations Center - Denver and Region VIII. June 1972.

2. DEVELOPMENT OF A WATER QUALITY MODEL FOR THE SOUTH PLATTE RIVER BASIN SYSTEM LAYOUT AND DATA REPORT 211B01179 TO ENVIRONMENTAL PROTECTION AGENCY. Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington, September 1972.

3. DEVELOPMENT OF A WATER QUALITY MODEL FOR THE SOUTH PLATTE RIVER BASIN - DOCUMENTATION REPORT. Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington. December 1972.

4 CLASSIFICATIONS AND NUMERIC STANDARDS - SOUTH PLATTE RIVER BASIN, LARAMIE RIVER BASIN, REPUBLICAN RIVER BASIN, SMOKY HILL RIVER BASIN. Colorado Department of Health, Water Quality Control Commission. 1981. (Amended 1984).

5 A SOP FOR FIELD SAMPLERS. Environmental Protection Agency, Region VIII, Denver, Colorado. September 1960.

6 METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES. Environmental Protection Agency, EPA-600/4-79-020. March 1979.

7 BIOLOGICAL FIELD AND LABORATORY METHODS FOR MEASURING THE QUALITY OF SURFACE WATERS AND EFFLUENTS, Environmental Protection Agency, EPA-670/4/73-001. July 1973.

8 AMBIENT WATER QUALITY CRITERIA FOR PHTHALATE ESTERS. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C., EPA 440/5-80-067. 1980.

9 BIOLOGY OF WATER POLLUTION, U.S. Department of the Interior, Federal Water Pollution Control Administration. 1976.

APPENDIX A

TOXIC HOT SPOT STUDY
SOUTH PLATTE RIVER ALONG THE FRONT RANGE

Station	Description	River Miles
THS-2	Plum Cr. at Teel Stables near Chatfield Reservoir	335/4.3
THS-1	So. Platte R. at Colo. 470 bridge	334.9
THS-3	So. Platte R. at Oxford Ave.	327.0
THS-4	Bear Cr. near mouth near Hampden & Bryant	326.4/0.4
THS-6	So. Platte R. near Evans Ave.	324.7
THS-5	Lakewood Gulch near Decatur & Howard	319.4/0.1
THS-7	Cherry Cr. near University Blvd.	317.7/4.2
THS-8	So. Platte R. at gaging sta. near 19th & Grinnell	317.3
THS-11	Sand Cr. at Burlington Ditch overflow	312.1/0.8
THS-12	Sand Cr. at Colfax, 1/2 mile W. of Tower Rd.	312.1/12
THS-9	Clear Cr. at York	311.1/0.3
THS-10	So. Platte R. at Hwy 224	310.9
THS-13	So. Platte R. at gaging sta. near Henderson	301.5
THS-15	Big Dry Cr. at County Rd.23 NW of Wattenberg	289.0/4.2
THS-16	Big Dry Cr. at Colo. 121 bridge	289.0/26.2
THS-21	St. Vrain Cr. at gaging sta. near Wildcat	270.0/1.3
THS-22	Boulder Cr. at County Rd. 20 1/2	270.0/17.4/1.6

THS-23	Boulder Cr. at Hwy 287 W. of Erie	270.0/17.4/10.1
THS-17	Coal Cr. at Coal Cr. Rd. SW of Superior	270.0/17.4/7.9/21.3
THS-19	Coal Cr. at Hwy 72 bridge near gaging station	270.0/17.4/7.9/29.9
THS-20	So. Boulder Cr. at Eldorado Springs	270.0/17.4/21.0/8.6
THS-27	Big Thompson R. bridge crossing E. of Loveland between 1st St. & Hwy 402	260.4/21.0
THS-30	Lt. Thompson R. near Hwy 257 & 60 W. of Milliken	260.4/7.0/0.1
THS-25	Cache La Poudre R. off Hwy 263 E. of Greeley	249.0/2.9
THS-26	Cache La Poudre R. at County Rd. 25 bridge SE of Windsor	249.0/18.5
THS-29	Cache La Poudre R. at Hospital Rd., E. side of Ft. Collins	249.0/43.6
THS-24	So. Platte R. at gaging sta., Hwy 37 bridge N. of Kersey	246.5
THS-14	O'Brian Canal near E. 120th Ave. crossing	
THS-31	Burlington Ditch at overflow to Sand Cr.	
THS-28	Fossil Cr. at So. Ft. Collins WWTP	
THS-28A	So. Ft. Collins WWTP outfall	

APPENDIX B

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-1

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	0820	MILITARY		
TEMPERATURE	15.0	C		
pH	7.6	SU		
FLOW	344	cfs		
ARSENIC	<50	ug/l	10	ug/g
BERYLLIUM	<10	ug/l	0.4	ug/g
CADMIUM	<5	ug/l	2.5	ug/g
CHROMIUM	<5	ug/l	11	ug/g
COPPER	<5	ug/l	3.4	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	151	ug/l	13,000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	15	ug/l	185	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	3.2	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	11	ug/l	36	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	118	mg/l		
AMMONIA	0.04	mg/l		
GROSS ALPHA	2	pci/l		
GROSS BETA	3	pci/l		
TOTAL COLIFORM	48	NO/100 ml		
FECAL COLIFORM	28	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-2

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	0850	MILITARY		
TEMPERATURE	20.0	C		
pH	7.9	SU		
FLOW	EST 15	cfs		
ARSENIC	<50	ug/l	1.0	ug/g
BERYLLIUM	<10	ug/l	<0.2	ug/g
CADMIUM	<5	ug/l	<0.1	ug/g
CHROMIUM	<5	ug/l	0.2	ug/g
COPPER	<5	ug/l	0.3	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	42	ug/l	1000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	6	ug/l	54	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	<0.6	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	<5	ug/l	2.8	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	136	mg/l		
AMMONIA	<0.02	mg/l		
GROSS ALPHA	1	pci/l		
GROSS BETA	4	pci/l		
TOTAL COLIFORM	800	NO/100 ml		
FECAL COLIFORM	220	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-3

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	0935	MILITARY		
TEMPERATURE	18.0	C		
pH	7.8	SU		
FLOW	273	cfs		
ARSENIC	<50	ug/l	14	ug/g
BERYLLIUM	<10	ug/l	0.7	ug/g
CADMIUM	<5	ug/l	2.7	ug/g
CHROMIUM	<5	ug/l	9.0	ug/g
COPPER	<5	ug/l	14	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	419	ug/l	12,000	ug/g
LEAD	<30	ug/l	13	ug/g
MANGANESE	44	ug/l	246	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	5	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	6	ug/l	53	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	123	mg/l		
AMMONIA	0.07	mg/l		
GROSS ALPHA	3	pci/l		
GROSS BETA	6	pci/l		
TOTAL COLIFORM	200	NO/100 ml		
FECAL COLIFORM	88	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-4

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	1000	MILITARY		
TEMPERATURE	18.0	C		
pH	7.8	SU		
FLOW	17	cfs		
ARSENIC	<50	ug/l	14	ug/g
BERYLLIUM	<10	ug/l	0.4	ug/g
CADMIUM	<5	ug/l	2.8	ug/g
CHROMIUM	<5	ug/l	10	ug/g
COPPER	<5	ug/l	7.3	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	843	ug/l	14,000	ug/g
LEAD	<30	ug/l	44	ug/g
MANGANESE	58	ug/l	179	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	2.7	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	21	ug/l	45	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	193	mg/l		
AMMONIA	0.04	mg/l		
GROSS ALPHA	5	pci/l		
GROSS BETA	7	pci/l		
TOTAL COLIFORM	980	NO/100 ml		
FECAL COLIFORM	450	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-5

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	1230	MILITARY		
TEMPERATURE	22.0	C		
pH	8.0	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	36	ug/g
BERYLLIUM	<10	ug/l	0.6	ug/g
CADMIUM	<5	ug/l	6.8	ug/g
CHROMIUM	<5	ug/l	18	ug/g
COPPER	20	ug/l	17	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	5770	ug/l	30,000	ug/g
LEAD	61	ug/l	16	ug/g
MANGANESE	232	ug/l	517	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	6.9	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	90	ug/l	99	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	173	mg/l		
AMMONIA	0.11	mg/l		
GROSS ALPHA	10	pci/l		
GROSS BETA	10	pci/l		
TOTAL COLIFORM	3800	NO/100 ml		
FECAL COLIFORM	1400	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-6

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	1040	MILITARY		
TEMPERATURE	19.0	C		
pH	7.8	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	60	ug/g
BERYLLIUM	<10	ug/l	1.9	ug/g
CADMIUM	<5	ug/l	68	ug/g
CHROMIUM	<5	ug/l	128	ug/g
COPPER	<5	ug/l	231	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	1200	ug/l	32,000	ug/g
LEAD	<30	ug/l	60	ug/g
MANGANESE	90	ug/l	665	ug/g
MERCURY	<0.1	ug/l	0.52	ug/g
NICKEL	<30	ug/l	36	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	5.6	ug/g
ZINC	22	ug/l	438	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	2.3	ug/g
HARDNESS AS CaCO3	154	mg/l		
AMMONIA	1.90	mg/l		
GROSS ALPHA	4	pci/l		
GROSS BETA	10	pci/l		
TOTAL COLIFORM	126,000	NO/100 ml		
FECAL COLIFORM	11,400	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-7

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	1110	MILITARY		
TEMPERATURE	22.0	C		
pH	7.6	SU		
FLOW	11	cfs		
ARSENIC	<50	ug/l	2	ug/g
BERYLLIUM	<10	ug/l	<0.2	ug/g
CADMIUM	<5	ug/l	0.4	ug/g
CHROMIUM	<5	ug/l	1.5	ug/g
COPPER	9	ug/l	2.2	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	3300	ug/l	2,000	ug/g
LEAD	<30	ug/l	18	ug/g
MANGANESE	131	ug/l	159	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	1.0	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	30	ug/l	17	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	314	mg/l		
AMMONIA	<0.02	mg/l		
GROSS ALPHA	13	pci/l		
GROSS BETA	17	pci/l		
TOTAL COLIFORM	6400	NO/100 ml		
FECAL COLIFORM	1980	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-8

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/12/82	MO/DAY/YR		
TIME	1250	MILITARY		
TEMPERATURE	22.0	C		
pH	8.1	SU		
FLOW	430	cfs		
ARSENIC	<50	ug/l	17	ug/g
BERYLLIUM	<10	ug/l	0.5	ug/g
CADMIUM	<5	ug/l	3.9	ug/g
CHROMIUM	<5	ug/l	14	ug/g
COPPER	7	ug/l	18	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	1350	ug/l	17,000	ug/g
LEAD	<30	ug/l	62	ug/g
MANGANESE	90	ug/l	264	ug/g
MERCURY	<0.1	ug/l	LA	ug/g
NICKEL	<30	ug/l	4.7	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	24	ug/l	109	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	-	ug/g
PHTHALATE ESTERS	≤5	ug/l	-	ug/g
HARDNESS AS CaCO3	167	mg/l		
AMMONIA	0.62	mg/l		
GROSS ALPHA	5	pci/l		
GROSS BETA	7	pci/l		
TOTAL COLIFORM	126,000	NO/100 ml		
FECAL COLIFORM	30,000	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-9

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	1115	MILITARY		
TEMPERATURE	25.0	C		
pH	7.7	SU		
FLOW	18	cfs		
ARSENIC	<50	ug/l	20	ug/g
BERYLLIUM	<10	ug/l	0.5	ug/g
CADMIUM	<5	ug/l	4.8	ug/g
CHROMIUM	<5	ug/l	20	ug/g
COPPER	8	ug/l	34	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	219	ug/l	17,000	ug/g
LEAD	<30	ug/l	25	ug/g
MANGANESE	98	ug/l	446	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	8.4	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	0.2	ug/g
ZINC	38	ug/l	287	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	159	mg/l		
AMMONIA	0.29	mg/l		
GROSS ALPHA	6	pci/l		
GROSS BETA	11	pci/l		
TOTAL COLIFORM	2800	NO/100 ml		
FECAL COLIFORM	1000	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - . THS-10

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	1135	MILITARY		
TEMPERATURE	25.4	C		
pH	7.2	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	12	ug/g
BERYLLIUM	<10	ug/l	0.3	ug/g
CADMIUM	<5	ug/l	2.9	ug/g
CHROMIUM	<5	ug/l	11	ug/g
COPPER	8	ug/l	22	ug/g
CYANIDE	8.8	ug/l	-	ug/g
IRON	674	ug/l	12,000	ug/g
LEAD	<30	ug/l	17	ug/g
MANGANESE	60	ug/l	283	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	5.9	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	0.2	ug/g
ZINC	30	ug/l	179	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	194	mg/l		
AMMONIA	4.5	mg/l		
GROSS ALPHA	5	pci/l		
GROSS BETA	11	pci/l		
TOTAL COLIFORM	4700	NO/100 ml		
FECAL COLIFORM	220	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-11

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	1255	MILITARY		
TEMPERATURE	25.0	C		
pH	7.4	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	8	ug/g
BERYLLIUM	<10	ug/l	0.2	ug/g
CADMIUM	<5	ug/l	1.4	ug/g
CHROMIUM	<5	ug/l	4.0	ug/g
COPPER	<5	ug/l	4.9	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	1160	ug/l	7000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	163	ug/l	124	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	2.3	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	12	ug/l	20	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	341	mg/l		
AMMONIA	0.38	mg/l		
GROSS ALPHA	11	pci/l		
GROSS BETA	16	pci/l		
TOTAL COLIFORM	580	NO/100 ml		
FECAL COLIFORM	580	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-12

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	1215	MILITARY		
TEMPERATURE	25.0	C		
pH	7.7	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	11	ug/g
BERYLLIUM	<10	ug/l	0.4	ug/g
CADMIUM	<5	ug/l	2.0	ug/g
CHROMIUM	<5	ug/l	6.0	ug/g
COPPER	<5	ug/l	6.4	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	447	ug/l	9000	ug/g
LEAD	<30	ug/l	1.6	ug/g
MANGANESE	16	ug/l	182	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	3.3	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	10	ug/l	30	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	143	mg/l		
AMMONIA	0.03	mg/l		
GROSS ALPHA	4	pci/l		
GROSS BETA	8	pci/l		
TOTAL COLIFORM	1000	NO/100 ml		
FECAL COLIFORM	560	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-13

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0800	MILITARY		
TEMPERATURE	25.2	C		
pH	6.0	SU		
FLOW	456	cfs		
ARSENIC	<50	ug/l	18	ug/g
BERYLLIUM	<10	ug/l	0.6	ug/g
CADMIUM	<5	ug/l	4.4	ug/g
CHROMIUM	<5	ug/l	19	ug/g
COPPER	9	ug/l	39	ug/g
CYANIDE	5.3	ug/l	-	ug/g
IRON	1350	ug/l	17,900	ug/g
LEAD	<30	ug/l	28	ug/g
MANGANESE	167	ug/l	269	ug/g
MERCURY	<0.1	ug/l	0.07	ug/g
NICKEL	<30	ug/l	9.8	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	0.2	ug/g
ZINC	39	ug/l	180	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	205	mg/l		
AMMONIA	LA	mg/l		
GROSS ALPHA	6	pci/l		
GROSS BETA	12	pci/l		
TOTAL COLIFORM	5700	NO/100 ml		
FECAL COLIFORM	1000	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-14

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0730	MILITARY		
TEMPERATURE	20.3	C		
pH	5.7	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	9	ug/g
BERYLLIUM	<10	ug/l	0.3	ug/g
CADMIUM	<5	ug/l	2.2	ug/g
CHROMIUM	<5	ug/l	62	ug/g
COPPER	<5	ug/l	16	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	2320	ug/l	6000	ug/g
LEAD	<30	ug/l	21	ug/g
MANGANESE	72	ug/l	291	ug/g
MERCURY	<0.1	ug/l	0.1	ug/g
NICKEL	<30	ug/l	5.6	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	1.1	ug/g
ZINC	15	ug/l	111	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	0.6	ug/g
HARDNESS AS CaCO3	171	mg/l		
AMMONIA	0.04	mg/l		
GROSS ALPHA	6	pci/l		
GROSS BETA	7	pci/l		
TOTAL COLIFORM	820	NO/100 ml		
FECAL COLIFORM	560	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-15

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0840	MILITARY		
TEMPERATURE	20.0	C		
pH	7.2	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	7	ug/g
BERYLLIUM	<10	ug/l	0.5	ug/g
CADMIUM	<5	ug/l	2.8	ug/g
CHROMIUM	<5	ug/l	14	ug/g
COPPER	23	ug/l	19	ug/g
CYANIDE	5.3	ug/l	-	ug/g
IRON	7840	ug/l	11,000	ug/g
LEAD	<30	ug/l	3.8	ug/g
MANGANESE	309	ug/l	187	ug/g
MERCURY	0.11	ug/l	0.05	ug/g
NICKEL	<30	ug/l	8.8	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	83	ug/l	80	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	348	mg/l		
AMMONIA	1.66	mg/l		
GROSS ALPHA	17	pci/l		
GROSS BETA	22	pci/l		
TOTAL COLIFORM	4600	NO/100 ml		
FECAL COLIFORM	3400	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-16

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1420	MILITARY		
TEMPERATURE	17.7	C		
pH	8.0	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	15	ug/g
BERYLLIUM	<10	ug/l	0.5	ug/g
CADMIUM	<5	ug/l	3.8	ug/g
CHROMIUM	<5	ug/l	8.7	ug/g
COPPER	<5	ug/l	9.1	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	727	ug/l	15,000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	375	ug/l	550	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	9.9	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	34	ug/l	47	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	90	mg/l		
AMMONIA	<0.02	mg/l		
GROSS ALPHA	3	pci/l		
GROSS BETA	7	pci/l		
TOTAL COLIFORM	240	NO/100 ml		
FECAL COLIFORM	55	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-17

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1125	MILITARY		
TEMPERATURE	21.6	C		
pH	8.0	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	11	ug/g
BERYLLIUM	<10	ug/l	0.4	ug/g
CADMIUM	<5	ug/l	1.9	ug/g
CHROMIUM	<5	ug/l	8.0	ug/g
COPPER	5	ug/l	6.0	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	59	ug/l	9000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	<5	ug/l	109	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	5.4	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	12	ug/l	28	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	58.2	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	128	mg/l		
AMMONIA	0.06	mg/l		
GROSS ALPHA	1	pci/l		
GROSS BETA	3	pci/l		
TOTAL COLIFORM	580	NO/100 ml		
FECAL COLIFORM	200	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-19

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1230	MILITARY		
TEMPERATURE	19.2	C		
pH	8.2	SU		
FLOW	1	cfs		
ARSENIC	<50	ug/l	5	ug/g
BERYLLIUM	<10	ug/l	0.2	ug/g
CADMIUM	<5	ug/l	1.3	ug/g
CHROMIUM	<5	ug/l	3.4	ug/g
COPPER	<5	ug/l	4.0	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	100	ug/l	7000	ug/g
LEAD	<30	ug/l	1.3	ug/g
MANGANESE	<5	ug/l	128	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	1.6	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	6	ug/l	19	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	LA	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	57	mg/l		
AMMONIA	<0.02	mg/l		
GROSS ALPHA	<1	pci/l		
GROSS BETA	2	pci/l		
TOTAL COLIFORM	240	NO/100 ml		
FECAL COLIFORM	40	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.
LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-20

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1200	MILITARY		
TEMPERATURE	12.3	C		
pH	8.8	SU		
FLOW	65	cfs		
ARSENIC	<50	ug/l	11	ug/g
BERYLLIUM	<10	ug/l	0.4	ug/g
CADMIUM	<5	ug/l	2.7	ug/g
CHROMIUM	<5	ug/l	16	ug/g
COPPER	<5	ug/l	5.5	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	91	ug/l	13,000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	8	ug/l	276	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	10	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	5	ug/l	32	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	15	mg/l		
AMMONIA	<0.02	mg/l		
GROSS ALPHA	<1	pci/l		
GROSS BETA	2	pci/l		
TOTAL COLIFORM	100	NO/100 ml		
FECAL COLIFORM	62	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.
LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-21

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	1000	MILITARY		
TEMPERATURE	20.0	C		
pH	7.1	SU		
FLOW	239	cfs		
ARSENIC	<50	ug/l	5	ug/g
BERYLLIUM	<10	ug/l	0.2	ug/g
CADMIUM	<5	ug/l	0.7	ug/g
CHROMIUM	<5	ug/l	4.3	ug/g
COPPER	6	ug/l	2.3	ug/g
CYANIDE	<2	ug/l	-	ug/g
IRON	3710	ug/l	4000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	108	ug/l	91	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	2.6	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	23	ug/l	11	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	546	mg/l		
AMMONIA	0.28	mg/l		
GROSS ALPHA	13	pci/l		
GROSS BETA	14	pci/l		
TOTAL COLIFORM	21,000	NO/100 ml		
FECAL COLIFORM	4300	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-22

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1000	MILITARY		
TEMPERATURE	22.6	C		
pH	8.2	SU		
FLOW	6.8	cfs		
ARSENIC	<50	ug/l	5	ug/g
BERYLLIUM	<10	ug/l	0.2	ug/g
CADMIUM	<5	ug/l	1.0	ug/g
CHROMIUM	<5	ug/l	5.4	ug/g
COPPER	5	ug/l	4.2	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	322	ug/l	6000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	29	ug/l	101	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	3.5	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	26	ug/l	16	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	294	mg/l		
AMMONIA	0.06	mg/l		
GROSS ALPHA	8	pci/l		
GROSS BETA	10	pci/l		
TOTAL COLIFORM	4900	NO/100 ml		
FECAL COLIFORM	410	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-23

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1035	MILITARY		
TEMPERATURE	22.6	C		
pH	7.7	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	8	ug/g
BERYLLIUM	<10	ug/l	0.3	ug/g
CADMIUM	<5	ug/l	1.6	ug/g
CHROMIUM	<5	ug/l	10	ug/g
COPPER	<5	ug/l	11	ug/g
CYANIDE	2.5	ug/l	-	ug/g
IRON	400	ug/l	7000	ug/g
LEAD	<30	ug/l	1.4	ug/g
MANGANESE	31	ug/l	9.4	ug/g
MERCURY	<0.1	ug/l	0.06	ug/g
NICKEL	<30	ug/l	6.4	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	0.2	ug/g
ZINC	150	ug/l	30	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	147	mg/l		
AMMONIA	0.46	mg/l		
GROSS ALPHA	2	pci/l		
GROSS BETA	5	pci/l		
TOTAL COLIFORM	760	NO/100 ml		
FECAL COLIFORM	340	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-24

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1250	MILITARY		
TEMPERATURE	25.0	C		
pH	7.2	SU		
FLOW	330	cfs		
ARSENIC	<50	ug/l	7	ug/g
BERYLLIUM	<10	ug/l	0.2	ug/g
CADMIUM	<5	ug/l	1.0	ug/g
CHROMIUM	<5	ug/l	4.6	ug/g
COPPER	<5	ug/l	7.3	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	1010	ug/l	5000	ug/g
LEAD	<30	ug/l	4.7	ug/g
MANGANESE	70	ug/l	171	ug/g
MERCURY	LA	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	3.4	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	15	ug/l	34	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	550	mg/l		
AMMONIA	0.08	mg/l		
GROSS ALPHA	21	pci/l		
GROSS BETA	19	pci/l		
TOTAL COLIFORM	480	NO/100 ml		
FECAL COLIFORM	250	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-25

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1220	MILITARY		
TEMPERATURE	22.0	C		
pH	7.0	SU		
FLOW	23	cfs		
ARSENIC	<50	ug/l	13	ug/g
BERYLLIUM	<10	ug/l	0.4	ug/g
CADMIUM	<5	ug/l	1.9	ug/g
CHROMIUM	<5	ug/l	12	ug/g
COPPER	7	ug/l	8.0	ug/g
CYANIDE	2.6	ug/l	-	ug/g
IRON	2620	ug/l	10,000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	225	ug/l	122	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	6.8	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	27	ug/l	60	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	645	mg/l		
AMMONIA	0.43	mg/l		
GROSS ALPHA	20	pci/l		
GROSS BETA	25	pci/l		
TOTAL COLIFORM	1180	NO/100 ml		
FECAL COLIFORM	1120	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-26

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	1100	MILITARY		
TEMPERATURE	18.0	C		
pH	7.1	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	2.7	ug/g
BERYLLIUM	<10	ug/l	<0.2	ug/g
CADMIUM	<5	ug/l	0.7	ug/g
CHROMIUM	<5	ug/l	3.4	ug/g
COPPER	<5	ug/l	2.0	ug/g
CYANIDE	3.0	ug/l	-	ug/g
IRON	2720	ug/l	4000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	104	ug/l	68	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	2.2	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	0.3	ug/g
ZINC	15	ug/l	9.2	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	572	mg/l		
AMMONIA	0.66	mg/l		
GROSS ALPHA	14	pci/l		
GROSS BETA	19	pci/l		
TOTAL COLIFORM	3300	NO/100 ml		
FECAL COLIFORM	910	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.
LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-27

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0805	MILITARY		
TEMPERATURE	20.0	C		
pH	7.1	SU		
FLOW	67	cfs		
ARSENIC	<50	ug/l	25	ug/g
BERYLLIUM	<10	ug/l	0.9	ug/g
CADMIUM	<5	ug/l	4.5	ug/g
CHROMIUM	5	ug/l	31	ug/g
COPPER	5	ug/l	21	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	1200	ug/l	22,000	ug/g
LEAD	<30	ug/l	<1.5	ug/g
MANGANESE	35	ug/l	282	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	17	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.3	ug/g
ZINC	17	ug/l	69	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	6.9	ug/g
HARDNESS AS CaCO3	190	mg/l		
AMMONIA	LA	mg/l		
GROSS ALPHA	5	pci/l		
GROSS BETA	9	pci/l		
TOTAL COLIFORM	1640	NO/100 ml		
FECAL COLIFORM	300	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-28

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0835	MILITARY		
TEMPERATURE	20.0	C		
pH	7.1	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	16	ug/g
BERYLLIUM	<10	ug/l	<0.5	ug/g
CADMIUM	6	ug/l	2.1	ug/g
CHROMIUM	<5	ug/l	13	ug/g
COPPER	<5	ug/l	7.8	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	2620	ug/l	10,000	ug/g
LEAD	<30	ug/l	<1.5	ug/g
MANGANESE	70	ug/l	137	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	9.2	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.3	ug/g
ZINC	16	ug/l	34	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	412	mg/l		
AMMONIA	0.15	mg/l		
GROSS ALPHA	14	pci/l		
GROSS BETA	15	pci/l		
TOTAL COLIFORM	1200	NO/100 ml		
FECAL COLIFORM	560	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-28A

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0905	MILITARY		
TEMPERATURE	20.0	C		
pH	6.9	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	64	ug/g
BERYLLIUM	<10	ug/l	1.4	ug/g
CADMIUM	<5	ug/l	6.9	ug/g
CHROMIUM	<5	ug/l	39	ug/g
COPPER	7	ug/l	26	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	85	ug/l	29,000	ug/g
LEAD	<30	ug/l	<1.5	ug/g
MANGANESE	18	ug/l	284	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	41	ug/l	29	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.3	ug/g
ZINC	10	ug/l	107	ug/g
PCB	≤5	ug/l	≤5	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	703	mg/l		
AMMONIA	0.03	mg/l		
GROSS ALPHA	8	pci/l		
GROSS BETA	11	pci/l		
TOTAL COLIFORM	2400	NO/100 ml		
FECAL COLIFORM	210	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-29

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/09/82	MO/DAY/YR		
TIME	0945	MILITARY		
TEMPERATURE	18.0	C		
pH	7.0	SU		
FLOW	116	cfs		
ARSENIC	<50	ug/l	16	ug/g
BERYLLIUM	<10	ug/l	<0.5	ug/g
CADMIUM	<5	ug/l	2.1	ug/g
CHROMIUM	<5	ug/l	13	ug/g
COPPER	<5	ug/l	7.8	ug/g
CYANIDE	≤2	ug/l	-	ug/g
IRON	242	ug/l	10,000	ug/g
LEAD	<30	ug/l	<1.5	ug/g
MANGANESE	16	ug/l	137	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	9.2	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.3	ug/g
ZINC	11	ug/l	34	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	-	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	93	mg/l		
AMMONIA	0.06	mg/l		
GROSS ALPHA	12	pci/l		
GROSS BETA	29	pci/l		
TOTAL COLIFORM	580	NO/100 ml		
FECAL COLIFORM	550	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-30

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	0935	MILITARY		
TEMPERATURE	18.1	C		
pH	7.1	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	9.0	ug/g
BERYLLIUM	<10	ug/l	0.3	ug/g
CADMIUM	<5	ug/l	1.4	ug/g
CHROMIUM	18	ug/l	15	ug/g
COPPER	16	ug/l	4.2	ug/g
CYANIDE	LA	ug/l	-	ug/g
IRON	17,300	ug/l	7000	ug/g
LEAD	<30	ug/l	<0.6	ug/g
MANGANESE	439	ug/l	316	ug/g
MERCURY	<0.1	ug/l	<0.05	ug/g
NICKEL	<30	ug/l	6.1	ug/g
SELENIUM	<50	ug/l	(1)	ug/g
SILVER	<5	ug/l	<0.1	ug/g
ZINC	69	ug/l	21	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	<0.5	ug/g
PHTHALATE ESTERS	≤5	ug/l	<0.5	ug/g
HARDNESS AS CaCO3	775	mg/l		
AMMONIA	0.31	mg/l		
GROSS ALPHA	31	pci/l		
GROSS BETA	36	pci/l		
TOTAL COLIFORM	3500	NO/100 ml		
FECAL COLIFORM	3100	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident,sample lost.

TOXIC HOT SPOT STUDY

STATION NUMBER - THS-31

PARAMETER	WATER		SEDIMENT	
	VALUE	UNITS	VALUE	UNITS
DATE	8/10/82	MO/DAY/YR		
TIME	1300	MILITARY		
TEMPERATURE	23.0	C		
pH	7.5	SU		
FLOW	-	cfs		
ARSENIC	<50	ug/l	-	ug/g
BERYLLIUM	<10	ug/l	-	ug/g
CADMIUM	<5	ug/l	-	ug/g
CHROMIUM	<5	ug/l	-	ug/g
COPPER	6	ug/l	-	ug/g
CYANIDE	2.0	ug/l	-	ug/g
IRON	672	ug/l	-	ug/g
LEAD	<30	ug/l	-	ug/g
MANGANESE	86	ug/l	-	ug/g
MERCURY	<0.1	ug/l	-	ug/g
NICKEL	<30	ug/l	-	ug/g
SELENIUM	<50	ug/l	-	ug/g
SILVER	<5	ug/l	-	ug/g
ZINC	24	ug/l	-	ug/g
PCB	≤5	ug/l	-	ug/g
PHENOL	<50	ug/l	-	ug/g
2,4,6 TRICHLOROPHENOL	≤5	ug/l	-	ug/g
PHTHALATE ESTERS	≤5	ug/l	-	ug/g
HARDNESS AS CaCO3	186	mg/l		
AMMONIA	1.41	mg/l		
GROSS ALPHA	6	pci/l		
GROSS BETA	10	pci/l		
TOTAL COLIFORM	-	NO/100 ml		
FECAL COLIFORM	-	NO/100 ml		

(1) Because of high iron concentrations, SELENIUM could not be determined.

LA = Laboratory accident, sample lost.

APPENDIX C

TOXIC HOT SPOT STUDY
BENTHOS, SOUTH PLATTE RIVER AND SELECTED TRIBUTARIES

STATION NUMBER / ORGANISMS	THS-1	THS-2	THS-3	THS-4	THS-5	THS-6	THS-7	THS-8	THS-9	THS-10	THS-13	THS-15
Turbellaria												
Dugesia sp.												
Nematoda					4	5						
Annelida												
Oligochaeta		Q	5	Q	4	1749	Q	301	35	Q	2475	Q
Hirudinea				Q		7		2			5	
Isopoda				Q				6			5	Q
Amphipoda												
Gammarus			3						1		1	
Hyalella azteca				Q							11	Q
Plecoptera												
Isogenoides elongatus		Q										
Doddsia occidentalis		Q										
Paracapnia angulatus												
Pteronarcella badia												
Claassenia sabulosa												
Aphinemura sp.												
Taenionema sp.												
Chloroperlidae												
Arcynopteryx compacta												
Isoperla bilineata												
Ephemeroptera												
Pseudocloeon sp.	31	Q	84	Q	11	205		19	5			
Tricorythodes sp.		Q	6	Q	45	86	Q	20	40	Q	6	
Baetis sp.		Q	1	Q	26	9		6	31	Q		
Stenonema sp.									1			
Callibaetis sp.							Q					
Caenis sp.												
Ephemerella sp.												
Paraleptophlebia sp.												
Ephemerella flavilinea												
Rhithrogena undulata												
Iron longimanus												
Heptagenia sp.												
Drunella sp.												
Ephemerella teresa												
Odonata												
Ophiogomphus sp.		Q				1	Q		1			Q
Amphiagrion sp.				Q		1	Q				1	
Argia sp.					Q							
Hemiptera												
Notonectidae												
Corixidae												

TOXIC HOT SPOT STUDY
BENTHOS, SOUTH PLATTE RIVER AND SELECTED TRIBUTARIES

STATION NUMBER ORGANISMS	THS-1	THS-2	THS-3	THS-4	THS-5	THS-6	THS-7	THS-8	THS-9	THS-10	THS-13	THS-15
Trichoptera												
Hydropsyche sp.	6		41	Q	4	3		1	11			
Cheumatopsyche sp.	2	Q	40	Q	2	12			14			
Ochrotrichia tarsalis		Q										
Agraylea multipunctata		Q										
Orthotrichia sp.		Q							1			
Ochrotrichia sp.												
Helicopsyche borealis												
Oecetis sp.												
Eobrachycentrus gelidae												
Glossosoma sp.												
Arctopsyche grandis												
Brachycentrus sp.												
Rhyacophila sp.												
Oligoplectrum sp.												
Oxyethira sp.												
Lepidoptera												
Paragyractis					1	1						
Coleoptera												
Elmidae												
Optioservus sp.		Q		Q								
Dubiraphia sp.		Q										
Dyticidae												
Hydaticus sp.							Q					
Copelatus sp.												
Hydroporus sp.												
Amphizoa sp.												
Diptera												
Chironomidae	18	Q	61	Q	145	315	Q	160	97	Q	587	Q
Tipulidae					4		Q					
Simuliidae												
Simulium sp.	103	Q	15	Q		55	Q	12			268	Q
Rhagionidae												
Atherix variegata												
Gastropoda												
Physidae												
Physa				Q		149	Q				519	Q
Pelecypoda												
Finger-nail clams												
TOTAL NUMBER OF KINDS	5	15	9	14	11	14	10	9	11	4	10	7
TOTAL NUMBER/SQ FT	160	15	256	14	247	2598	10	527	237	4	3878	7
TOTAL NUMBER/SQ M	1722	161	2755	151	2658	27,954	108	5671	2550	43	41,727	75

Q - Equals organisms collected qualitatively, arbitrarily assigned a value of one for computing.
Number/sq m = number/sq ft x 10.76

TOXIC HOT SPOT STUDY
BENTHOS, SOUTH PLATTE RIVER AND SELECTED TRIBUTARIES

STATION NUMBER / ORGANISMS	THS-16	THS-17	THS-19	THS-20	THS-21	THS-22	THS-23	THS-25	THS-26	THS-27	THS-29	THS-30
Turbellaria												
Dugesia sp.	0						16					
Nematoda			3									
Annelida												
Oligochaeta		27	133			145	120		34	94	3	
Hirudinea	0	243					3					
Isopoda											2	
Amphipoda												
Gammarus		1					12					
Hyalella azteca	0	47										0
Plecoptera												
Isogenoides elongatus												
Doddsia occidentalis			1									
Paracapnia angulatus			1									
Pteronarcella badia			23	3								
Claassenia sabulosa			4	5								
Aphineaura sp.			4	1								
Taenionema sp.			4									
Chloroperlidae			33									
Arcynopteryx compacta				1								
Isoperla bilineata				1								
Ephemeroptera												
Pseudocloeon sp.		8	3	9			25		54	140	1	0
Tricorythodes sp.	0	172				1	11			5	7	0
Baetis sp.	0	113	12	5	0	5	119			46	1	
Stenonema sp.												
Callibaetis sp.												
Caenis sp.		467		1								
Ephemerella sp.		3		1								
Paraleptophlebia sp.			3	1								
Ephemerella flavilinea			7									
Rhithrogena undulata				116							1	
Iron longimanus				0								
Heptagenia sp.				0								
Drunella sp.				4								
Ephemerella teresa				0								
Odonata												
Ophiogomphus sp.												
Amphiagrion sp.		60				1						
Argia sp.												
Hemiptera												
Notonectidae												
Corixidae	0					62						

TOXIC HOT SPOT STUDY
BENTHOS, SOUTH PLATTE RIVER AND SELECTED TRIBUTARIES

STATION NUMBER / ORGANISMS	THS-16	THS-17	THS-19	THS-20	THS-21	THS-22	THS-23	THS-25	THS-26	THS-27	THS-29	THS-30
Trichoptera												
Hydropsyche sp.									183	84	35	Q
Cheumatopsyche sp.	Q	995	881	51		3	39		744	58	67	Q
Ochrotrichia tarsalis			368	1								
Agraylea multipunctata												
Orthotrichia sp.		1										
Ochrotrichia sp.	Q											
Helicopsyche borealis		161	1									
Oecetis sp.		11	10									
Eobrachycentrus gelidae			1									
Glossosoma sp.				108								
Arctopsyche grandis				3								
Brachycentrus sp.				164							1	
Rhyacophila sp.				1								
Oligoplectrum sp.				25								
Oxyethira sp.		1										
Lepidoptera												
Paragyractis		8										
Coleoptera												
Elmidae												
Optioservus sp.		7	288	4								
Dubiraphia sp.												
Dyticidae												
Hydaticus sp.	Q											
Copelatus sp.			Q									
Hydroporus sp.			3									
Amphizoa sp.			59									
Diptera												
Chironomidae	Q	28	29	43	Q	199	31	Q	454	9	53	Q
Tipulidae			16	1							6	
Simuliidae												
Simulium sp.	Q	313	9	2	Q	537	395	Q	42	5		Q
Rhagionidae												
Atherix variegata				Q								
Gastropoda												
Physidae												
Physa	Q	9	12			25	77	Q				
Pelecypoda												
Finger-nail clams		4	Q									
TOTAL NUMBER OF KINDS	12	21	27	27	3	8	11	3	6	8	11	7
TOTAL NUMBER/SQ FT	12	2679	1910	555	3	916	848	3	1511	441	177	7
TOTAL NUMBER/SQ M	129	28,826	20,551	5972	32	9856	9124	32	16,258	4745	1905	75

Q - Equals organisms collected qualitatively, arbitrarily assigned a value of one for computing.
Number/sq m = number/sq ft x 10.76